Electronic Version 1.1

Stylesheet Version v1.1.1

Description

LUBRICATION DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS:

[0001] The present application is a continuation patent application of International Application No. PCT/SE02/02185 filed 27 November 2002 which was published in English pursuant to Article 21(2) of the Patent Cooperation Treaty, and which claims priority to Swedish Application No. 0104121-9 filed 6 December 2001. Both applications are expressly incorporated herein by reference in their entireties.

[0002] The present invention relates to a device for delivering lubricant to at least one lubrication point, and that includes a lubricant reservoir connected to the lubrication point via a valve arrangement.

BACKGROUND ART

[0003] Hydraulic cylinders are used, for example, in vehicles and in particular in construction machines such as excavators, wheel loaders and waist-or chassis-steered vehicles. According to the invention, in a preferred embodiment, a wheel loader is provided with two load arms, and at least one hydraulic cylinder that is designed to raise or lower the load arms in relation to the vehicle. There is a need with such an hydraulic cylinder to be able to deliver lubricant easily and efficiently to bearings arranged at

the bearing point of the hydraulic cylinder on the load arm and on the vehicle in order to reduce wear in the bearing.

[0004] The use of time-controlled devices for delivering lubricant to such bearings is known. Such a time-controlled device delivers a predetermined quantity of lubricant to a bearing with a certain time interval. The time between each lubrication pulse is adjusted in order to deliver the quantity of lubricant needed in order to minimize the risk of wear in the bearing under the normal working load of the hydraulic cylinder.

[0005] One disadvantage with such a device is that lubricant is delivered to the bearing at each predetermined lubrication pulse regardless of the actual need for lubricant.

[0006] This means that under a high working load in the hydraulic cylinder, an insufficient quantity of lubricant is delivered to the bearing in relation to the actual need, which can lead to problems of wear and tear in the bearing.

[0007] Furthermore, at low working load in the hydraulic cylinder an excessive quantity of lubricant is delivered in relation to the actual need, which leads to problems of excess lubricant in the bearing.

[0008] Another disadvantage with such a device is that since lubricant is delivered when the bearing is under load, the lubricant will not be distributed right around the bearing. This is the case, in particular, in bearings with a small angle of rotation since there is a risk that a part of the bearing will never receive a sufficient quantity of lubricant.

DISCLOSURE OF INVENTION

[0009] A primary object of the present invention is to provide an improved device for delivering lubricant to a bearing, in which the aforementioned problems are resolved. The invention comprises (includes, but is not limited to) a device for delivering lubricant to a lubrication point. A lubricant reservoir is connected to the lubrication point via a valve arrangement. The invention is characterized by the fact that the device comprises means designed to cyclically control the valve arrangement as a function of the pressure in a hydraulic circuit connected to the device, with a lubrication pulse being emitted each time. A pressure drop in the circuit follows what had previously been a sufficiently high pressure level.

[0010] The invention affords a number of advantages. First, it may be noted that a device according to the invention provides a lubrication device in which lubricant is delivered to a bearing in proportion to the working load in an hydraulic cylinder, and hence also to the actual need of the bearing. This results first and foremost in a reduced risk of damage, but also in a reduced need for servicing and maintenance which in turn leads to more reliable operation, lower costs and increased productivity. The fact that the lubrication device is controlled as a function of the pressure in a hydraulic circuit connected to the device and to the hydraulic cylinder provides a solution which also means that timed control, by means of a timer, for example, is not required.

[0011] In a bearing, the tolerances are never less than a certain ever-present degree of play.

[0012] If the bearing is placed under load, the bearing closes more tightly on one side and consequently a degree of play occurs on the other side. This means that when lubricant is delivered while the bearing is under load, penetration is difficult on the side that is under load where the bearing closes more tightly. Further, a greater part of the lubricant therefore collects on the other side of the bearing; that is to say, on the side least subject to wear, and therefore least in need of lubrication. The fact that the solutions (devices) according to the present invention deliver lubricant when the bearing is not under load means that the lubricant will be more readily distributed evenly throughout the bearing. This is particularly advantageous in the case of highly stressed bearings having a small angle of rotation.

[0013] Further advantages and objects of the invention can be inferred from the patent claims below and from the following description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention is explained in more detail below with reference to a preferred exemplary embodiment and to the included drawings, in which:

[0015] Figure 1 is a side view of an including wheel loader; and

[0016] Figure 2 is a schematic view of an hydraulic connection configured according to the teachings of the present invention.

MODE FOR THE INVENTION

[0017] Figure 1 shows a side view of a wheel loader 1 in which the invention can

be used.

[0018] The wheel loader 1 is provided with an articulated arm system which comprises two parallel load arms (of which only one load arm 2 can be seen from the side view of Figure 1) and two hydraulic cylinders (of which only one hydraulic cylinder 3 is shown in Figure 1). The hydraulic cylinders 3 are designed to raise and/or lower the load arms 2 in relation to the wheel loader 1. The hydraulic cylinder 3 has two bearing points, one bearing point 4 on the load arm 2 and one bearing point (obscured in Figure 1) on the vehicle 1. The articulated arm system further comprises an implement 5 pivoted at the outer ends of the load arms 2, such as a pallet fork or bucket, together with articulated arms 6a, 6b, 6c connected to an upper joint axis 7 of the implement 5 for operation thereof.

[0019] Figure 2 shows a schematic connection diagram 8 of a preferred embodiment of the invention in which a reservoir 9 for lubricant 10a is firmly mounted in the vehicle 1.

[0020] The reservoir 9 comprises a piston loaded by a spring 11, hereinafter called a pump piston 12, fitted inside the reservoir 9. The pump piston 12 is designed to be capable of moving in two opposite directions in the reservoir 9, upward and downward in Figure 2, and in the case of downward movement, to exert pressure on the lubricant 10a stored in the reservoir 9. The reservoir 9 is topped up by a lubricant gun (not shown) via a nipple 13 fitted to the reservoir 9.

[0021] A dipstick 14 is arranged in the pump piston 12 in order to make it easier

to read off the quantity of lubricant 10a in the reservoir 9. The dipstick 14 is arranged in such a way that one end thereof is fixed to the pump piston 12 and the other end thereof extends outside the reservoir 9. The dipstick 14 is at the same time designed, though a cover 15 fitted to the top of the reservoir 9, to follow the movement of the pump piston 12 in the reservoir 9 and allows the quantity of lubricant 10a in the reservoir 9 to be read off. The reservoir 10 is connected by way of a valve arrangement 16 to a bearing 17. The valve arrangement 16 comprises a chamber 18 connected to the mouth of the reservoir 9 together with a first non- return valve 19 and a second non-return valve 20 in order to produce a one-way flow of lubricant 10a, 10b from the reservoir 9 through the chamber 18 to the bearing 17. The first non-return valve 19 is fitted adjacent to the outlet of the reservoir 9 and permits a flow of lubricant 10a, 10b from the reservoir 9 to the chamber 18. The second non-return valve 20 is fitted at the inlet to a delivery duct 21 connected to the bearing 17 and permits a flow of lubricant 10b from the chamber 18 to the bearing 17.

[0022] The non-return valves 19,20 comprise a ball 22a, 22b, which by means of a spring 23a, 23b is pressed against a seat so that lubricant 10a, 10b can flow past the ball 22a, 22b while the spring 23a, 23b is compressed.

[0023] A piston, hereinafter called a control piston 25, loaded by an elastic element in the form of a spring 24, is arranged at the chamber 18 in order to control the valve arrangement 16. The control piston 25 is designed, under the influence of a hydraulic circuit 26 connected to the control piston 25, to be capable of moving in two opposite directions in the chamber 18,

upward and downward according to Figure 2, and in the case of a downward movement, to exert pressure on the lubricant 10b enclosed in the chamber 18. The downward movement of the control piston 25 is limited by a stop shoulder 27 arranged in the chamber 18. The upward movement of the control piston 25 in opposition to the spring 24 is limited by a stop screw 28. By adjusting the position of the stop screw 28, it is possible to define the stroke of the control piston 25 and hence the quantity of lubricant 10b which the bearing 17 receives at each lubrication pulse. The function in the form of a lubrication cycle in a lubrication device 10a, 10b according to the invention will be described in more detail below with reference to Figure 2.

[0024] When an hydraulic pump (not shown) causes the pressure in the hydraulic circuit 26 to rise from a lower to a higher pressure, the control piston 25 moves toward the stop screw 28 under action of the spring 24. This means that the volume in the chamber 18 increases, which in turn causes the pressure therein to fall. When the pressure in the chamber 18 is lower than the pressure in the reservoir 9, the first non-return valve 19 opens and lubricant 10a is forced into the chamber 18. The second non-return valve 20 is loaded by a spring 23b, the spring constant of which is selected so that the non-return valve 20 is kept closed against the chamber 18.

[0025] When the pressure in the hydraulic circuit 26 then falls to a lower level, the control piston 25 is pressed back to its basic position against the check valve 27 by the spring 24. This means that the pressure in the chamber 18

increases, which in turn means that the first non-return valve 19 is closed and the second non-return valve 20 is opened, and lubricant 10b is forced through the second non-return valve 20 and out to the bearing 17 via the delivery duct 21.

[0026] One lubrication cycle is thereby completed and the next one occurs when pressure falls following a pressure rise in the hydraulic circuit 26 sufficient to compress the spring 24 acting in opposition to the control piston 25.

[0027] The invention is not confined to the exemplary embodiment described above and shown in the drawings, but can be freely modified within the scope of the patent claims. For example, the invention is not limited to use on wheel loaders, but can be used on all types of vehicle in which hydraulic cylinders are used.

[0028] The invention can also be used for delivering lubricant to lubrication points other than the bearing points on the hydraulic cylinders. For example, lubricant can be delivered to bearing points of the articulated arms on the load arms.

[0029] According to the exemplary embodiment above, the second non-return valve is opened by the lubricant when the pressure in the chamber exceeds a specific value.

[0030] In another embodiment of the invention, the elastic element may alternatively be designed to open the valve directly, for example mechanically by way of a linkage system. As an alternative to a helical coil spring, the elastic element may take the form of other elements, such as a

body of an elastic material, for example, which yields for pressure loading and returns to its original shape once the pressure is removed.

[0031] In another embodiment of the invention, the housing from a common grease gun is used together with associated grease cartridges in place of a lubricant reservoir.

[0032] In yet another embodiment, the reservoir is topped up via a centrally located lubricant stock coupled to the reservoir. The term reservoir must be interpreted in context and encompasses various types of arrangements in which a cavity is at least partially enclosed by a number of walls. For example, a tube or a conduit or a part thereof must also be included.